

Status of Work on Helix up the Ramp

Y.Alexahin

The largest loss of pbars in the Tevatron now occurs in the end of the ramp (at energies > 500 GeV where the voltage on main separators, B11H & C17V, reaches its maximum) and the beginning of the squeeze.

Up the ramp the transition takes place from the new injection helix (introduced in May 2002) to the old one which uses only two separators (B11H & C17V) and provides too small separation at A0.

We use as a figure of merit the so-called “radial separation”

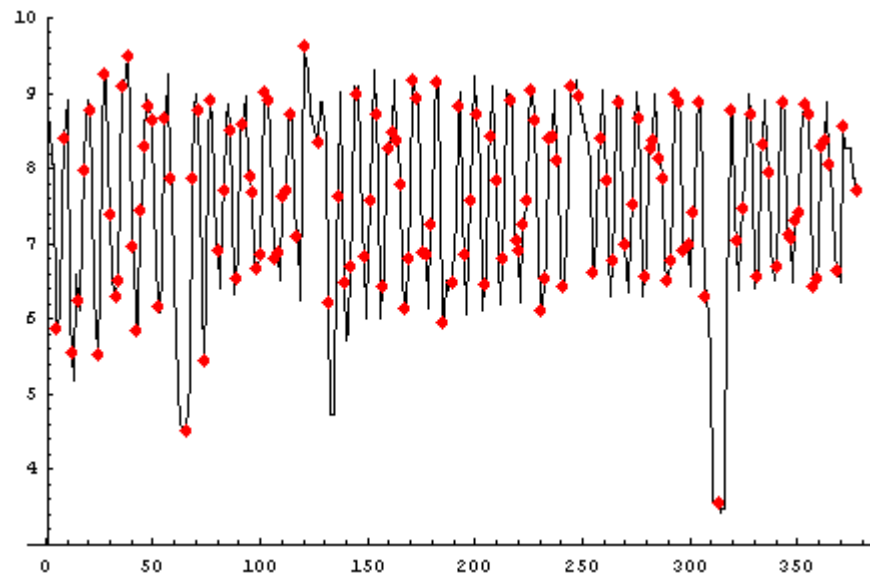
$$S = \sqrt{\left(d_x / \sigma_x^{(\beta)}\right)^2 + \left(d_y / \sigma_y^{(\beta)}\right)^2}$$

where

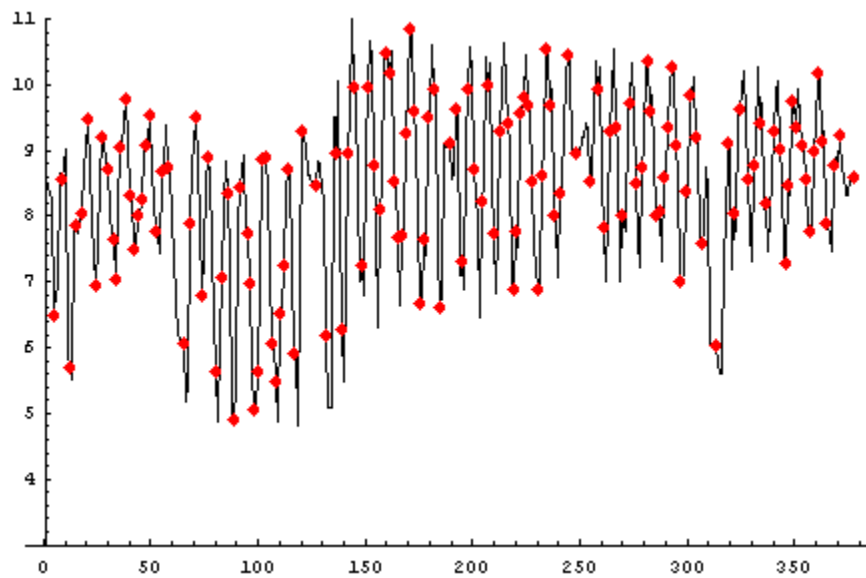
$$\sigma_{x,y}^{(\beta)} = \sqrt{\beta_{x,y} \mathcal{E}_{\text{r.m.s.}}}$$

is the betatron part of the r.m.s. beam sizes

**Radial separation at all 138 interaction points with squeeze step1 helix
(injection cogging) at 980 GeV:**



present (2001) helix starting from B0 (reference emittance 15π mm mrad)



proposed helix

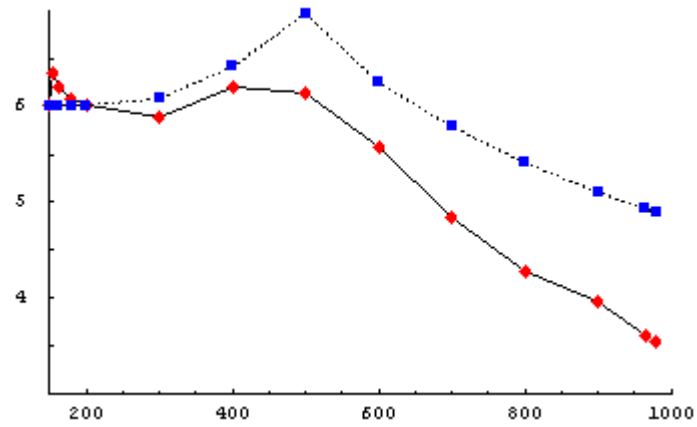
Beam-beam effects at flattop with the present and proposed helices

helix	step	S_{\min}	$ \Delta v_x _{\max}$	$ \Delta v_y _{\max}$	$ \mathbf{R}_{50} _{\max} \cdot 10^{12}$	$ \mathbf{R}_{07} _{\max} \cdot 10^{13}$
present	EoR	3.26	.0066	.0031	2.02	1.45
	BoS	3.09	.0078	.0031	2.33	2.54
new	EoR	4.46	.0033	.0016	1.07	0.31
	BoS	4.60	.0045	.0021	1.31	0.51

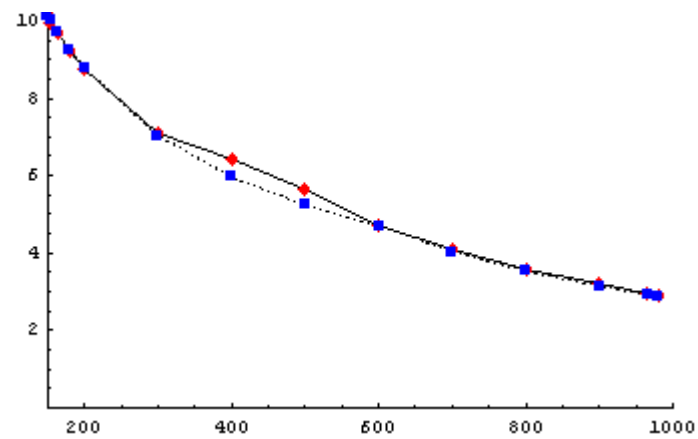
Table 1. Maximum beam-beam tunes shifts and resonance driving terms with the present and new helices. The cogging is different at the end of ramp (EoR) and the beginning of squeeze (BoS).

The new helix promises significant reduction in the beam-beam effects

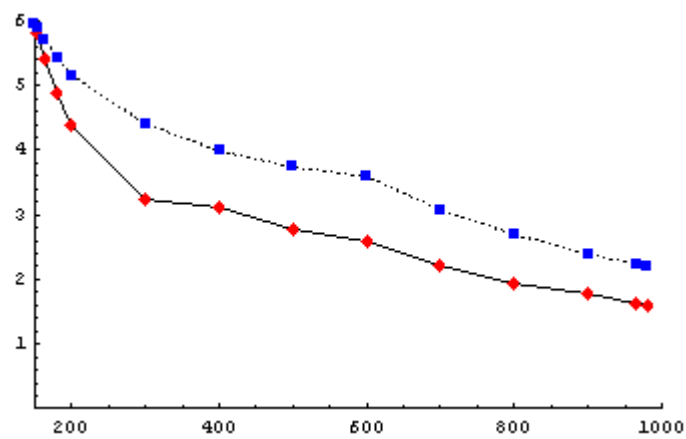
Calculated helix up the ramp



Minimum “radial” separation (σ 's) vs. energy. Red – present helix, blue – new helix

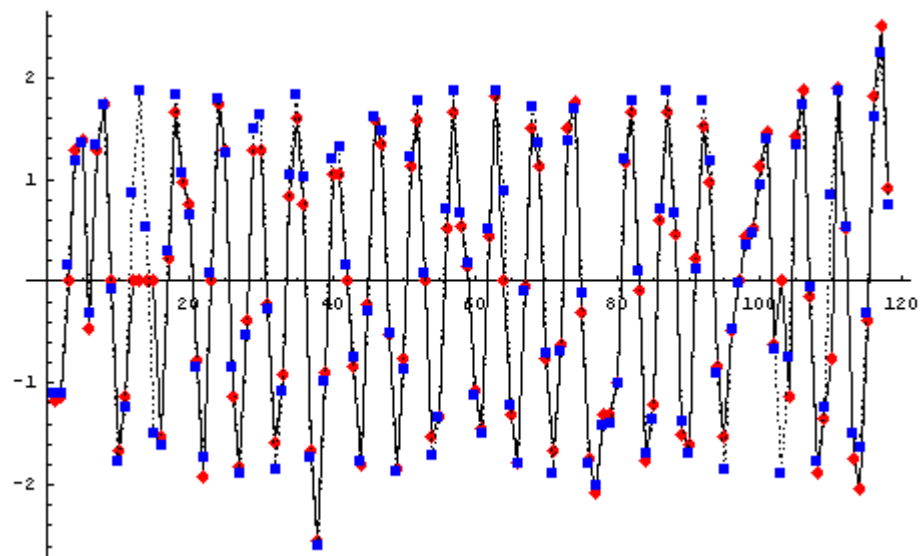


Maximum horizontal orbit [mm] vs. energy

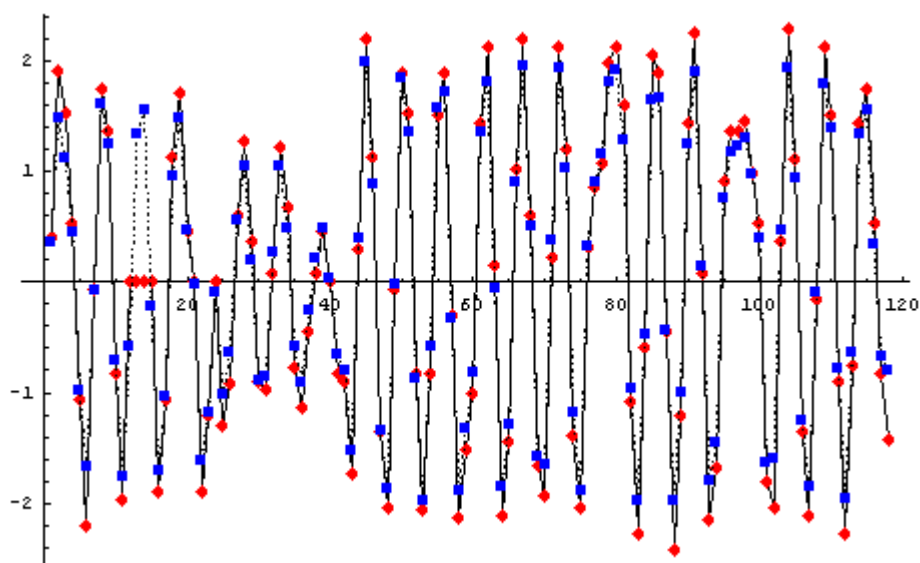


Maximum vertical orbit [mm] vs. energy

Measured proton helix at flattop (red), blue – design.

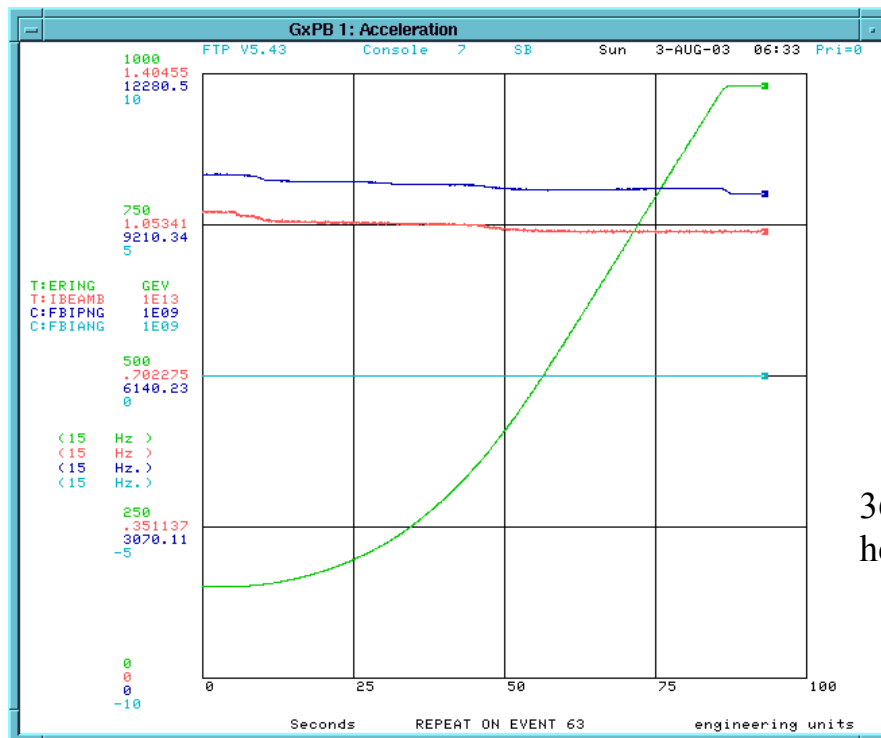
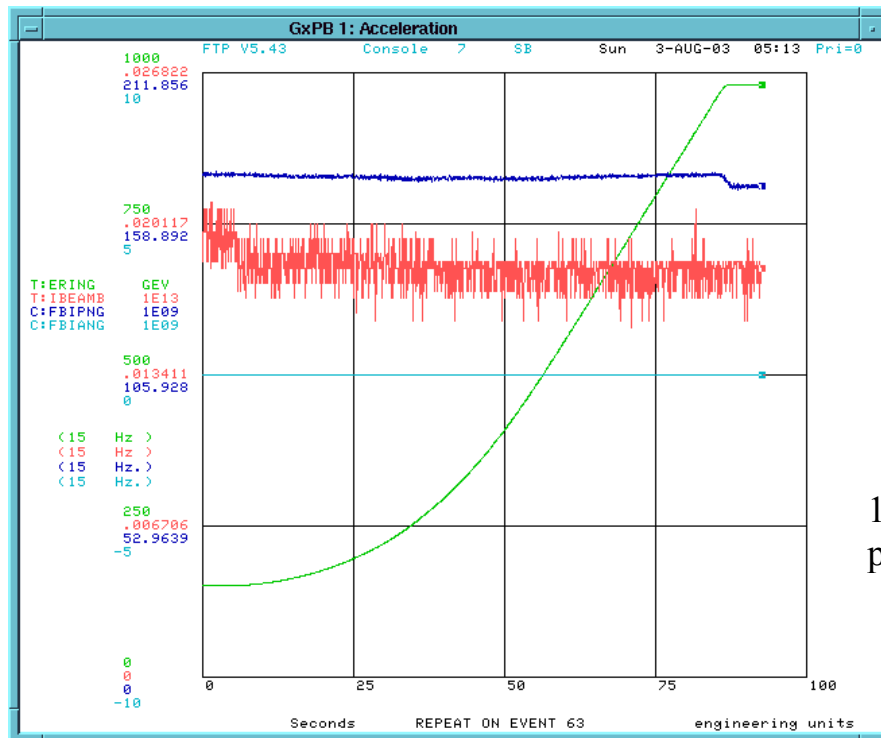


Horizontal orbit [mm] at HBPMs starting from HBPMB0D

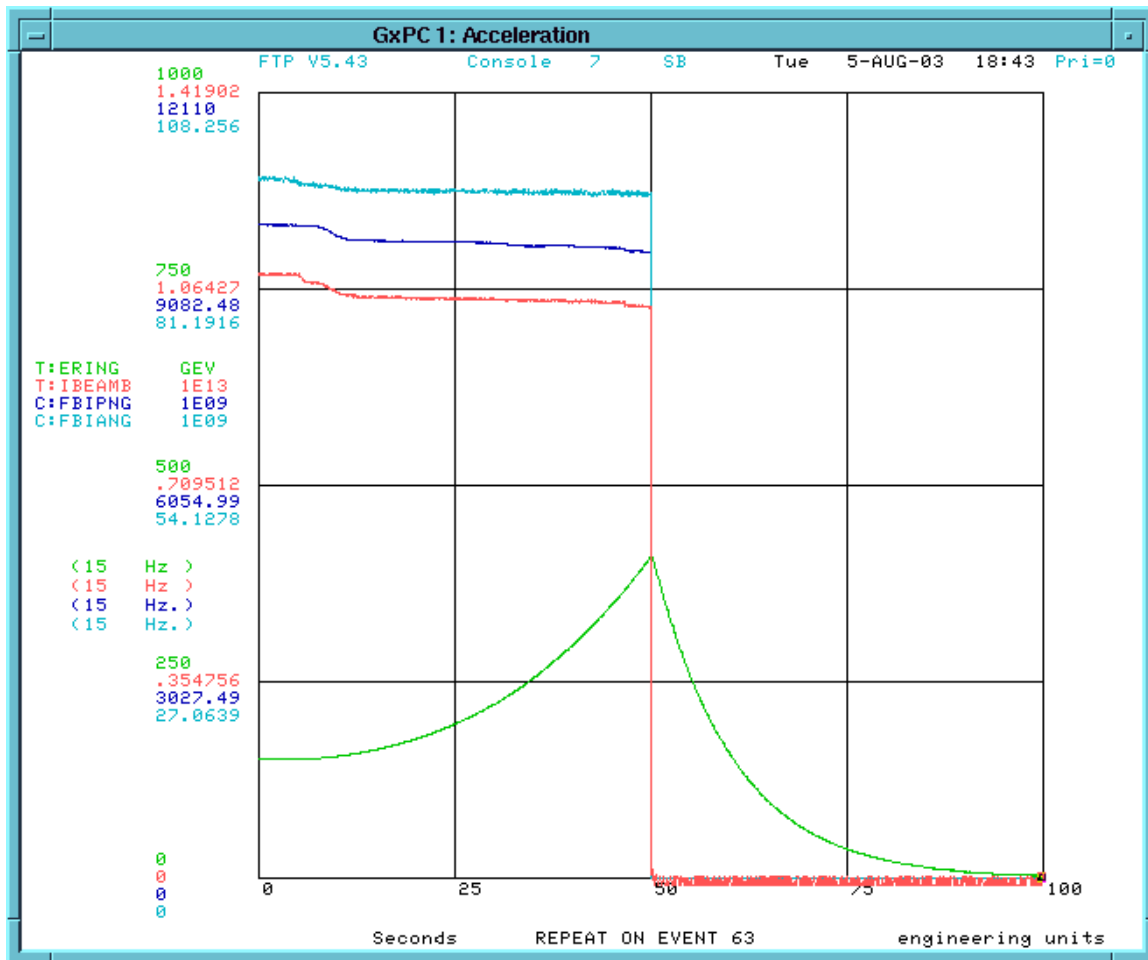


Vertical orbit [mm] at VBPMs starting from VBPMB0D

First results with the new helix (08/03/03)



Ramping 36x4 (08/05/03)



The reason of the quench was not understood. As a precaution the following steps will be taken:

1. Center the orbit where high losses were seen
2. Keep the old helix up to 400 GeV and only then make transition to the new helix